$\mathcal{P}$

DEPARTMENT OF

PHYSICS

GRAMBLING COLLEGE

Grambling, Louisiana

3b

SEMI-ANNUAL STATUS REPORT

SUBMITTED TO:

NASA Scientific & Technical
   Information Facility
P. O. Box 33
College Park, Maryland   20740

REFERENCE NUMBER:

NGR-19-011-007
Supplement No. 3

INSTITUTION:

Grambling College
Grambling, Louisiana   71245

TITLE:

A Proposal to Continue Study-
ing Low Frequency Hydromagne-
tic Waves Using ATS-1 Data

PRINCIPAL INVESTIGATOR:

W. D. Cummings
Professor
Department of Physics

DURATION:
   (Original Grant)
   (Supplement No. 1)
   (Supplement No. 2)
   (Supplement No. 3)

One (1) Year
One (1) Year
One (1) Year
One (1) Year

SUM GRANTED BY NASA:
   (Original Grant)
   (Supplement No. 1)
   (Supplement No. 2)
   (Supplement No. 3)

$11,421
$11,987
$11,997
$13,272

DATE:
   (Original Grant)
   (Supplement No. 1)
   (Supplement No. 2)
   (Supplement No. 3)

December 1, 1970
December 1, 1971
December 1, 1972
December 1, 1973

SIGNATURE:
   Principal Investigator
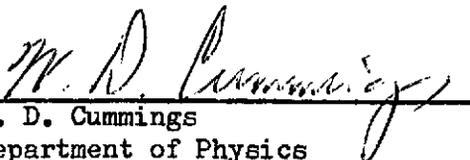
W. D. Cummings
Department of Physics
Grambling College
Grambling, LA   71245

2<

Semi-Annual Status Report

for a

STUDY OF LOW FREQUENCY HYDROMAGNETIC WAVES
USING ATS-1 DATA
(NGR-19-011-007)

by

W. D. Cummings
Department of Physics
Grambling College

Introduction:

We continue to focus on three areas in the analysis of ATS-1 data:

(1) Study the relation between these oscillations and other
geomagnetic phenomena.

(2) Study the polarization of the waves.

(3) Development of a catalog of events in the frequency range 0-100
milli-Hz. This would cover the micropulsation ranges Pc3, Pc4,
and Pc5 (10 sec$<$ T$<$600 sec).

Relation to other geomagnetic phenomena:

It has become increasingly clear to us that the oscillations we are

observing at ATS-1 are associated with the recovery phase of magnetic storms.

We have been trying to discover at what point in the recovery phase that

oscillations are most likely to begin. We used the catalog of hourly values

of equatorial Dst (Sugiura and Poros, 1971) to determine the time of the main

phase decrease, and we used our own catalog of oscillations (January through

May, 1968) to determine the onset time of oscillations as observed at ATS-1.

For each oscillation event at ATS-1, we sought the nearest prior main phase

decrease with a magnitude of at least -35γ, and measured the time difference

between the onset of the event at ATS-1 and the time of the main phase decrease. Figure 1 shows a histogram of these time differences. In making this histogram we have excluded the predominantly compressional oscillations that usually occur during the main phase.

The figure indicates that the most probable time to observe the onset of transverse oscillations is within 24 hours after the main phase decrease.

Calvin Countee and Fred Gordon have been involved in this phase of the analysis.

Polarization:

The students who have recently been involved in this phase of the data analysis are Calvin Countee and Ramana Murty. Calvin has written a computer program to plot streamlines for plasma flow through the magnetosphere. We wanted to compare the orientation of the polarization ellipse for a given event to the direction of a local streamline. In Figure 2 we have superimposed the orientation of the major axis of the polarization ellipse for an event of long duration on a plot of equatorial streamlines in the vicinity of ATS-1

Catalog:

The progress of the catalog remains slow, owing to problems that I have previously discussed. We have completed five months of data, and I believe we will be able to complete at least one year of 1968 before November 30, 1974.

Interest in the catalog continues to increase, as the enclosed sample request letter indicates.

Donald Lyons, William Wiley, Jim Alexander, Gloria Pleasant, and Benjamin Clark have been working on the catalog.

Dr. W.D. Cummings
Department of Physics
Grambling College,
Grambling, La. 71245
U.S.A.

March 14 ,1974

Dear Dr. Cummings,

At the present time we are comparing the pulsations
Pc 3-4, observed on the ground with the pulsations, registered
inside and outside the magnetosphere.

For such work we would like to have your "Catalog of
Low-Frequency Oscillations of the Earth's Magnetic Field as
Observed at ATS-I" for the whole 1968 year. Up to now we have
received only two issues of those catalogs for March and April
1968.

If you could send us these catalogs for the above-
mentioned and any other periods, we would be very much obliged
to you.

Thank you in advance,

Sincerely yours,

V. Troitskaya

5<

FIGURE CAPTIONS

Figure 1: A lagtime is defined as the difference between the time of onset
           of osciallations observed at ATS-1 and the time of the first
           prior minimum in the geomagnetic field (Dst) that is greater than
           or equal to -35 γ. The figure shows a histogram of these lag-
           times for the events observed at ATS-1 during January through
           May, 1968.

Figure 2: The flow of plasma through the equatorial plane of the magneto-
           sphere is indicated by theoretical streamlines. The orientation
           of the major axis of the polarization ellipse for oscillations
           observed at ATS-1 is also indicated.

HISTOGRAM of LAGTIMES
between
MINIMA in MAGNETIC
STORM FIELD
and the
ONSET of WAVES
at ATS – I

(Jan. thru May, 1968)

No. of Events

Lagtimes (hrs.)
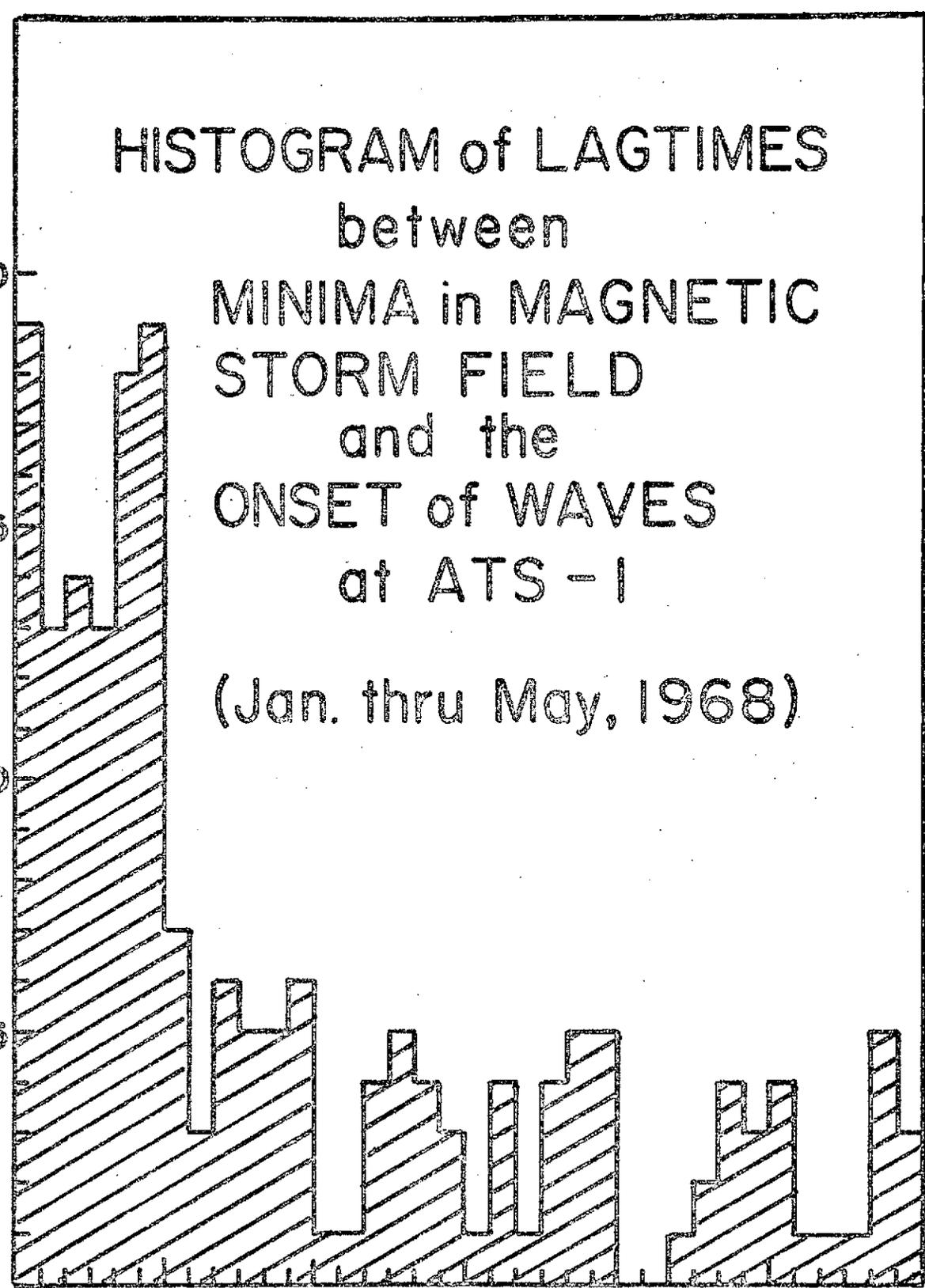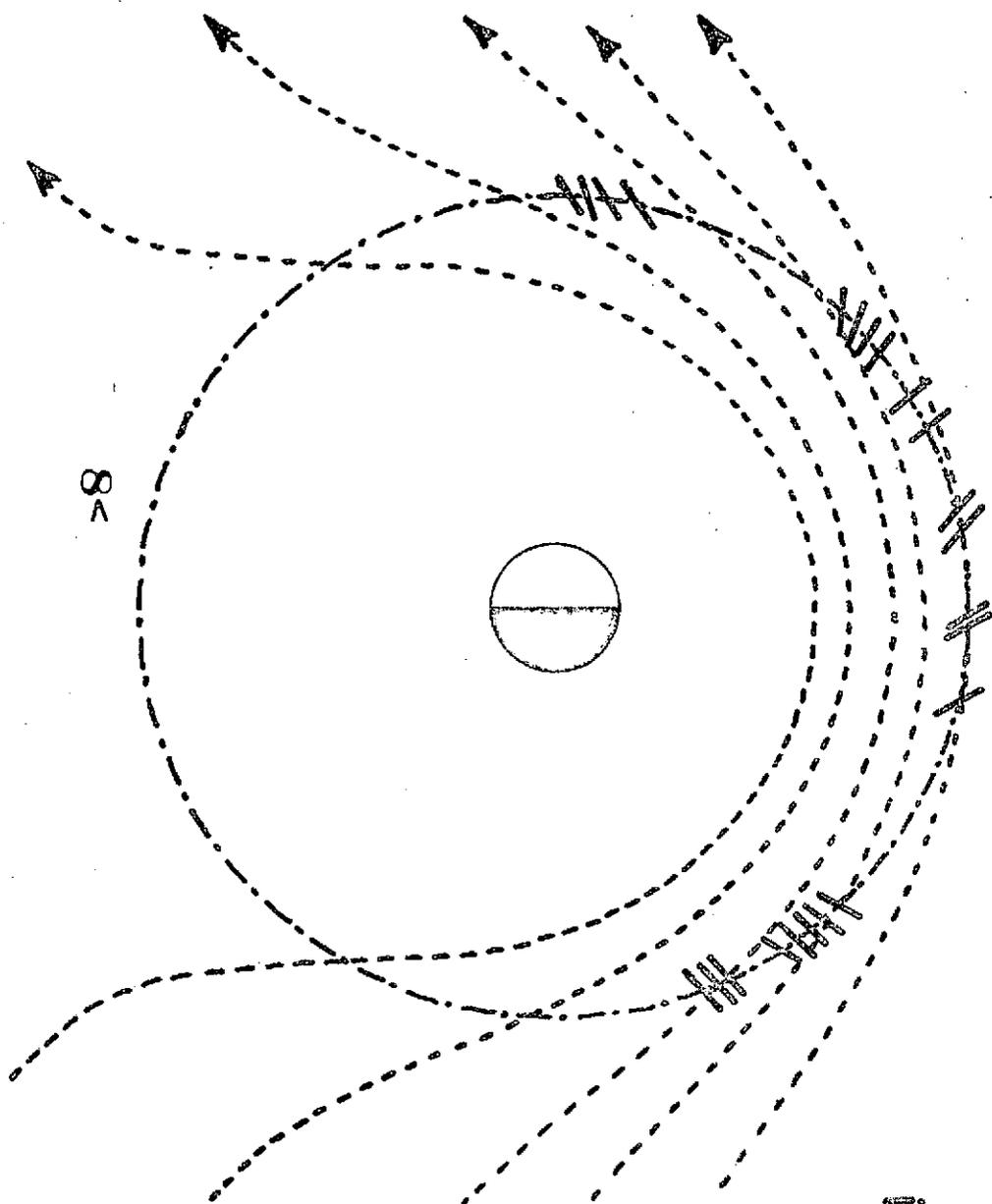
Figure 1

- - -► Theoretical Streamlines
— · — · ATS - I Orbit
/// Major Axis of
     Polarization Ellipse

Jan. 18, 1967

Figure 2

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During January, 1968

W. D. Cummings and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

October 31, 1973

9<

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During January, 1968

W. D. Cummings and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

Introduction

The attached catalog of events has been prepared to facilitate a comparison

of ATS-1 data with other ground and satellite magnetometer data. We have begun

the catalog in March, 1968, when the ATS-1 data begins to overlap data from the

DODGE satellite. We hope to eventually catalog all our data for 1967, 1968, and

1969.

Explanation of the Catalog

In this catalog an event is defined as an oscillation of the magnetic field

with a duration of at least ten minutes, and a frequency that remains roughly

constant. Events are distinguished on the basis of the frequency of the oscil-

lation, e.g., when a high frequency oscillation is superimposed upon a lower

frequency oscillation, two events are identified.

The oscillations of an event usually occur in bursts that are typically one

hour in duration. In a burst the amplitude of the oscillation begins at a low

level, grows to a maximum, and then decreases to a low level again. Because the

oscillation begins with a low amplitude, it is often difficult to exactly specify

the beginning time of the event.

The beginning time is given in Universal Time. ATS-1 is stationed in the geographic equatorial plane at a geocentric distance of 6.6 R_E and at 150° W longitude. One can easily arrive at the Local Time for the beginning of the event by subtracting 10 hours from the Universal Time (or by adding 14 hours if the hour of the beginning time (U.T.) is less than 10).

Gaps of as much as an hour may occur between bursts in a given event. However, we defind the duration of an event as the time interval between the beginning of the first burst and the end of the last burst.

We have used microfilm copies of the data at 0.32 second averages to measure the time interval between successive peaks. We tried to make at least ten such measurements during an event to determine the average period. In a few cases we were unable to make ten measurements, but in all cases we made at least five. The error figure associated with the average period is the standard deviation of the individual measurements of the period. This error figure is more a measure of the real variability of the time interval between successive peaks than it is of uncertainty in determining that time interval.

The average frequency was determined by inverting each individual measurement of the time interval between successive peaks and then averaging these individual measurements of the frequency. The error figure associated with the average frequency is the standard deviation of the individual measurements of the frequency.

Acknowledgements

Semi-Annual Status Report

for a

STUDY OF LOW FREQUENCY HYDROMAGNETIC WAVES

USING ATS-1 DATA

(NGR-19-011-007)

by

W. D. Cummings
Department of Physics
Grambling College

June 26, 1974

1<

Low Frequency Oscillations in the Earth's Magnetic Field

Observed at ATS-1

January, 1968

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T (Sec.)	Average Frequency f (milli-Hz)
01	Jan 01	00	57	126	100.0 ± 12.0	10.1 ± 1.3
02	01	20	00	113	59.5 ± 9.8	17.2 ± 2.8
03	02	00	30	136	72.6 ± 5.2	13.8 ± 1.1
04	02	03	34	60	56.8 ± 9.3	18.1 ± 3.1
05[a]	02	04	45	99	44.0 ± 5.1	23.0 ± 2.7
06	02	12	19	86	66.2 ± 8.1	15.3 ± 1.7
07	02	15	49	51	83.3 ± 6.5	12.1 ± 1.0
08	02	18	20	323	80.5 ± 12.5	12.7 ± 2.0
09	02	19	06	230	354.3 ± 81.3	2.9 ± 0.6
10	03	02	35	70	97.2 ± 11.9	10.4 ± 1.4
11	03	19	20	335	65.8 ± 7.0	15.4 ± 1.7
12	04	02	09	139	88.3 ± 8.2	11.4 ± 1.1
13	04	09	19	44	117.8 ± 8.4	8.5 ± 0.6
14	04	19	52	38	77.5 ± 7.6	13.0 ± 1.3
15	04	21	45	292	133.0 ± 16.2	7.6 ± 0.9
16	05	07	30	25	46.7 ± 3.2	21.5 ± 1.3
17	05	10	52	17	78.9 ± 3.9	12.7 ± 0.6
18	06	02	19	99	83.6 ± 20.4	12.6 ± 3.0
19	06	07	30	85	104.0 ± 11.2	9.7 ± 1.1
20	06	16	29	206	28.8 ± 3.0	35.2 ± 4.1
21	06	21	22	12	68.3 ± 12.4	15.0 ± 2.5

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min)	Average Period T (Sec)	Average Frequency f (milli-Hz)
22	06	22	57	62	32.2 ± 2.1	31.2 ± 1.9
23	07	01	40	39	32.0 ± 3.7	31.6 ± 3.9
24	07	18	28	167	27.1 ± 1.6	37.5 ± 2.2
25	08	18	48	250	56.9 ± 6.3	17.8 ± 2.3
26	09	20	54	136	158.4 ± 15.2	6.4 ± 0.7
27	10	20	40	10	31.9 ± 2.6	31.5 ± 2.7
28	10	23	36	14	32.1 ± 3.8	31.5 ± 3.8
29	12	22	52	53	37.9 ± 4.5	26.7 ± 3.4
30[a]	13	05	42	15	55.4 ± 11.2	18.6 ± 3.7
31	13	17	47	119	29.3 + 3.1	34.2 ± 2.5
32	14	23	02	93	69.5 ± 10.2	14.7 ± 2.7
33	15	01	30	37	121.8 ± 17.3	8.4 ± 1.2
34	15	08	31	37	49.4 ± 2.4	20.3 ± 1.0
35	16	00	35	151	142.8 ± 13.4	7.1 ± 0.6
36	16	20	50	61	20.7 ± 3.8	49.8 ± 8.6
37	16	22	36	383	75.9 ± 13.4	13.6 ± 2.9
38	17	12	27	68	67.0 ± 4.8	15.0 ± 1.1
39	17	14	56	242	28.6 ± 6.0	36.3 ± 6.9
40	17	20	15	289	24.0 ± 6.0	44.1 ± 10.3
41	18	02	50	90	112.3 ± 18.3	9.1 ± 1.4
42	18	05	25	87	49.1 ± 6.6	20.7 ± 2.7
43	18	23	09	116	63.9 ± 5.4	15.8 ± 1.3
44	19	00	59	13	28.1 ± 1.9	35.8 ± 2.3
45	19	11	05	90	46.8 ± 1.8	21.4 ± 0.8
46	19	16	16	564	25.8 ± 2.9	39.2 ± 3.9

Event No.	Beginning Time (U.T.)			Duration (Min.)	Average Period T (Sec)	Average Frequency f (milli-Hz)
	Day	Hour	Min.			
47	20	06	28	214	88.4 ± 9.3	11.4 ± 1.3
48	20	08	15	18	44.8 ± 7.1	22.9 ± 4.5
49	20	16	28	228	26.1 ± 2.4	38.7 ± 3.7
50	21	00	06	76	27.0 ± 3.9	38.0 ± 7.0
51	21	04	15	171	58.5 ± 14.3	18.3 ± 5.4
52	21	17	42	402	52.6 ± 5.9	19.3 ± 2.4
53	21	18	12	367	24.4 ± 2.9	41.6 ± 5.4
54	22	16	09	536	24.4 ± 2.2	41.3 ± 3.8
55	22	15	22	164	46.2 ± 7.4	22.2 ± 3.6
56	23	17	08	526	31.4 ± 6.5	33.1 ± 6.3
57	23	21	59	193	160.6 ± 19.3	6.3 ± 0.8
58[a]	27	03	55	175	195.4 ± 63.3	5.6 ± 1.8
59	27	08	10	72	41.5 ± 8.2	25.0 ± 5.5
60[a]	28	02	02	28	41.9 ± 10.9	25.4 ± 7.2
61	28	20	42	17	69.4 ± 5.4	14.5 ± 1.2
62[a]	29	00	38	24	66.4 ± 16.0	15.8 ± 3.4
63	29	02	40	124	117.0 ± 81.0	12.6 ± 7.8
64	29	23	45	185	82.5 ± 17.0	12.6 ± 2.5
65	30	04	46	14	174.3 ± 2.2	5.7 ± 0.1
66	30	11	02	82	80.7 ± 6.6	12.5 ± 1.1
67	30	20	02	378	69.8 ± 15.8	15.0 ± 3.1

[a]Measurements made on B_z only.

High resolution data not available from January 21, Hr. 00 to January 27, Hr. 03.

13<

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1
During February, 1968

by

W.D. Cummings, F. Mason, and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

May 18, 1973

14<

Catalog os Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During February, 1968

W.D. Cummings, F. Mason, and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

Introduction

The attached catalog of events has been prepared to facilitate a comparison of ATS-1 data with other ground and satellite magnetometer data. We have begun the catalog in March, 1968, when the ATS-1 data begins to overlap data from the DODGE satellite. We hope to eventually catalog all out data for 1967, 1968 and 1969.

Explanation of the Catalog

In this catalog an event is defined as an oscillation of the magnetic field with a duration of at least ten minutes, and a frequency that remains roughly constant. Events are distinguished on the basis of the frequency of the oscillation, e.g., when a high frequency oscillation is superimposed upon a lower frequency oscillation, two events are identified.

The oscillations of an event usually occur in bursts that are typically one hour in duration. (In a burst the amplitude of the oscillation begins at a low level, grows to a maximum, and then decreases to a low level again. Because the oscillation begins with a low amplitude, it is often difficult to exactly specify the beginning time of the event.

The beginning time is given in Universal Time. ATS-1 is stationed in the geographic equatorial plane at a geocentric distance of 6.6 R_E and at 150° W longitude. One can easily arrive at the Local Time for the beginning of the event by subtracting 10 hours from the Universal Time (or by adding 14 hours if the hour of the beginning time (U.T.) is less than 10).

Gaps of as much as an hour may occur between bursts in a given event. However, we defind the duration of an event as the time interval between the beginning of the first burst and the end of the last burst.

We have used microfilm copies of the data at 0.32 second averages to measure the time interval between successive peaks. We tried to make at least ten such measurements during an event to determine the average period. In a few cases we were unable to make ten measurements, but in all cases we made at least five. The error figure associated with the average period is the standard deviation of the individual measurements of the period. This error figure is more a measure of the real variability of the time interval between successive peaks than it is of uncertainty in determining that time interval.

The average frequency was determined by inverting each individual measurement of the time interval between successive peaks and then averaging these individual measurements of the frequency. The error figure associated with the average frequency is the standard deviation of the individual measurements of the frequency.

Acknowledgements

Low Frequency Oscillations in the Earth's Magnetic Field

Observed at ATS-1

February, 1968

Event No.	Beginning Time(U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(milli-Hz)
01	Feb. 01	19	18	62	68.8 $\pm$ 3.1	14.6 $\pm$ 0.7
02	04	18	33	343	71.5 $\pm$ 10.1	14.3 $\pm$ 2.3
03	06	00	04	78	107.3 $\pm$ 4.6	9.3 $\pm$ 0.4
04	07	17	30	602	98.0 $\pm$ 4.2	10.2 $\pm$ 0.4
05	10	01	16	24	119.8 $\pm$ 25.1	8.6 $\pm$ 1.7
06	11	20	19	93	80.4 $\pm$ 10.3	12.6 $\pm$ 1.6
07	13	05	21	235	55.8 $\pm$ 5.2	18.0 $\pm$ 1.6
08	13	12	19	791	75.0 $\pm$ 11.8	13.8 $\pm$ 2.9
09	14	17	32	548	91.8 $\pm$ 13.8	11.2 $\pm$ 1.9
10	15	06	39	66	89.8 $\pm$ 15.5	11.7 $\pm$ 3.1
11	15	19	39	312	44.2 $\pm$ 8.8	23.4 $\pm$ 4.2
12	17	04	26	62	129.4 $\pm$ 23.0	7.9 $\pm$ 1.3
13	17	07	58	46	44.0 $\pm$ 2.8	22.8 $\pm$ 1.4
14	17	10	48	272	78.5 $\pm$ 14.0	13.1 $\pm$ 2.4
15	17	22	06	158	126.8 $\pm$ 21.9	8.1 $\pm$ 1.6
16	18	06	48	219	81.3 $\pm$ 12.9	12.7 $\pm$ 2.7
17	19	00	30	53	64.5 $\pm$ 4.6	15.6 $\pm$ 1.1
18	19	06	20	123	54.4 $\pm$ 8.2	18.8 $\pm$ 3.1
19	19	20	53	247	52.3 $\pm$ 4.6	19.2 $\pm$ 1.6

Event No.	Beginning Time(U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(milli-Hz)
20	Feb. 20	10	50	25	95.2 ± 6.4	10.5 ± 0.7
21	20	17	40	150	35.9 ± 5.1	28.3 ± 3.9
22	20	22	25	145	25.0 ± 4.7	41.0 ± 6.1
23	22	01	37	71	59.3 ± 11.2	17.4 ± 3.4
24	23	17	06	211	77.1 ± 9.0	13.2 ± 2.0
25	23	21	30	160	105.4 ± 1.8	9.5 ± 0.2
26	25	19	22	82	147.4 ± 7.2	6.8 ± 0.4
27	26	17	34	780	134.8 ± 14.8	7.5 ± 0.9
28	28	01	45	495	117.8 ± 18.2	8.7 ± 1.3
29	28	10	40	50	110.8 ± 18.5	9.3 ± 1.6
30	28	20	08	25	142.3 ± 5.6	7.0 ± 0.3
31	28	22	44	211	233.4 ± 41.3	4.4 ± 0.8

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During March, 1968

by

W.D. Cummings and F. Mason
Department of Physics
Grambling College
Grambling, La.   71245

December 21, 1972

19<

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During March, 1968

W. D. Cummings and F. Mason
Department of Physics
Grambling College
Grambling, La.   71245

Introduction

The attached catalog of events has been prepared to facilitate a comparison of ATS-1 data with other ground and satellite magnetometer data. We have begun the catalog in March, 1968, when the ATS-1 data begins to overlap data from the DODGE satellite. We intend to continue the catalog through 1968, and eventually come back to January and February. We also hope to catalog our data for 1967 and 1969.

Explanation of the Catalog

In this catalog an event is defined as an oscillation of the magnetic field with a duration of at least ten minutes, and a frequency that remains roughly constant. Events are distinguished on the basis of the frequency of the oscillation, e.g., when a high frequency oscillation is superimposed upon a lower frequency oscillation, two events are identified.

The oscillations of an event usually occur in bursts that are typically one hour in duration. In a burst the amplitude of the oscillation begins at a low level, grows to a maximum, and then decreases to a low level again. Because the oscillation begins with a low amplitude, it is often difficult to exactly specify the beginning time of the event.

The beginning time is given in Universal Time. ATS-1 is stationed in the geographic equatorial plane at a geocentric distance of 6.6 R_E and at 150° W longitude. One can easily arrive at the Local Time for the beginning of the event by subtracting 10 hours from the Universal Time (or by adding 14 hours if the hour of the beginning time (U.T.) is less than 10).

Gaps of as much as an hour may occur between bursts in a given event. However, we define the <u>duration</u> of an event as the time interval between the beginning of the first burst and the end of the last burst.

We have used microfilm copies of the data at 0.32 second averages to measure the time interval between successive peaks. We tried to make at least ten such measurements during an event to determine the <u>average period</u>. In a few cases we were unable to make ten measurements, but in all cases we made at least five. The <u>error figure</u> associated with the average period is the standard deviation of the individual measurements of the period. This error figure is more a measure of the real variability of the time interval between successive peaks than it is of uncertainty in determining that time interval.

The <u>average frequency</u> was determined by inverting each individual measurement of the time interval between successive peaks and then averaging these individual measurements of the frequency. The <u>error figure</u> associated with the average frequency is the standard deviation of the individual measurements of the frequency.

Further Cataloging

To distribute this initial catalog, we have used a mailing list provided by the UCLA group. If you would like to receive additional catalogs as they become available, or if you know of someone who would be interested in these

catalogs, please so inform us by writing to:

Department of Physics
Grambling College
P. O. Box 515
Grambling, La.   71245

Acknowledgements

22<

Low Frequency Oscillations in the Earth's Magnetic Field

Observed at ATS-1
March, 1968

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(milli-Hz)
1	Feb 29	20	57	290	78.9 ± 7.6	12.8 ± 1.2
2	Mar 01	20	22	62	61.8 ± 3.3	16.2 ± 0.8
3	01	21	10	180	285.2 ± 45.2	3.6 ± 0.5
4	02	00	54	141	45.6 ± 5.6	22.2 ± 2.8
5	02	21	50	260	56.6 ± 4.2	17.8 ± 1.3
6	03	03	07	63	80.9 ± 20.6	13.0 ± 3.3
7[a]	03	07	33	101	54.9 ± 10.2	18.8 ± 3.2
8	03	23	32	98	66.0 ± 7.0	15.3 ± 1.6
9	04	01	33	51	111.9 ± 19.4	9.2 ± 1.5
10	04	06	58	19	45.7 ± 3.5	22.0 ± 1.9
11	04	13	47	53	62.0 ± 7.9	16.4 ± 2.2
12	04	23	04	26	50.9 ± 8.2	20.1 ± 3.2
13	05	00	02	104	88.7 ± 22.8	12.0 ± 3.1
14	05	03	58	74	37.1 ± 5.0	27.6 ± 4.6
15[a]	05	06	02	13	57.1 ± 4.6	17.6 ± 1.4
16	05	07	51	11	53.2 ± 6.3	19.0 ± 2.0
17	05	19	30	375	64.6 ± 11.4	15.9 ± 2.5
18	06	20	00	116	48.4 ± 9.4	21.3 ± 3.9
19	07	22	37	203	88.3 ± 8.1	11.4 ± 1.1
20	08	03	55	37	147.3 ± 14.3	6.8 ± 0.6

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(milli-Hz)
21	08	18	55	205	96.1 ± 11.9	10.6 ± 1.4
22	09	01	10	120	105.7 ± 15.8	9.7 ± 1.4
23	10	00	20	145	164.5 ± 12.7	6.1 ± 0.5
24	10	04	58	52	81.8 ± 10.3	12.4 ± 1.5
25	10	06	52	120	52.0 ± 3.0	19.3 ± 1.0
26	10	13	35	17	89.6 ± 11.3	11.3 ± 1.4
27	11	03	22	15	72.2 ± 8.8	14.0 ± 1.6
28	15	17	37	175	25.7 ± 2.5	39.3 ± 3.5
29	16	01	28	35	144.3 ± 10.3	7.0 ± 0.5
30[a]	16	03	40	65	68.2 ± 8.2	14.8 ± 1.8
31	16	09	10	17	42.7 ± 6.4	21.6 ± 3.4
32	16	20	6	32	26.7 ± 2.6	37.8 ± 4.0
33	17	00	9	51	35.3 ± 3.6	28.7 ± 3.4
34	22	19	40	17	57.4 ± 4.5	17.5 ± 1.4
35	24	00	55	30	141.1 ± 26.9	7.3 ± 1.2
36[a]	24	04	57	93	103.2 ± 13.7	9.8 ± 1.5
37	25	03	47	25	38.2 ± 3.4	26.3 ± 2.4
38	25	22	35	75	54.4 ± 6.5	18.6 ± 2.3
39	27	11	30	40	60.6 ± 4.1	16.5 ± 1.1
40	27	23	10	95	67.5 ± 4.9	14.9 ± 1.1
41	29	00	25	106	126.6 ± 7.9	7.9 ± 0.5
42	29	18	20	240	53.4 ± 6.3	19.0 ± 2.3
43	29	19	52	123	410.8 ± 19.3	2.4 ± 0.3
44[a]	30	01	19	11	87.0 ± 12.2	11.7 ± 1.5

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(milli-Hz)
45	30	07	55	227	61.4 ± 7.9	16.5 ± 1.9
46	30	20	48	17	69.9 ± 10.2	14.6 ± 2.0
47[b]	30	23	30	80	312.7 ± 36.6	3.2 ± 0.4
48	31	01	45	40	83.9 ± 12.1	12.1 ± 1.7
49	31	15	58	27	25.2 ± 1.6	39.8 ± 2.5

[a]Measurements made on $B_{\dot{z}}$ only.

[b]Beginning time and duration are uncertain because a gap in the data preceded the event.

The following gaps in the ATS-1 data are noted:

    (1) From March 11, Hr. 08, Min. 0 to March 15, Hr. 13, Min. 0

    (2) From March 18, Hr. 08, Min. 0 to March 22, Hr. 13, Min. 0

    (3) From March 25, Hr. 15, Min. 12 to March 25, Hr. 15, Min. 33

    (4) From March 30, Hr. 22, Min. 0 to March 30, Hr. 23, Min 29

Catalog of Low-Frequency Oscillations

of the

Earth's Magnetic Field as Observed at ATS-1

During April, 1968

by

W.D. Cummings, F. Mason, and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

March 2, 1973

26<

Catalog of Low-Frequency Oscillations

of the

Earth's Magnetic Field as Observed at ATS-1

During April, 1968

W.D. Cummings, F. Mason, and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

Introduction

The attached catalog of events has been prepared to facilitate a comparison

of ATS-1 data with other ground and satellite magnetometer data. We have begun

the catalog in March, 1968, when the ATS-1 data begins to overlap data from the

DODGE satellite. We intend to continue the catalog through 1968, and eventually

come back to January and February. We also hope to catalog our data for 1967

and 1969.

Explanation of the Catalog

In this catalog an event is defined as an oscillation of the magnetic field

with a duration of at least ten minutes, and a frequency that remains roughly

constant. Events are distinguished on the basis of the frequency of the oscil-

lation, e.g., when a high frequency oscillation is superimposed upon a lower

frequency oscillation, two events are identified.

The oscillations of an event usually occur in bursts that are typically

one hour in duration. In a burst the amplitude of the oscillation begins at a

low level, grows to a maximum, and then decreases to a low level again. Because

the oscillation begins with a low amplitude, it is often difficult to exactly

specify the beginning time of the event.

The beginning time is given in Universal Time. ATS-1 is stationed in the geographic equatorial plane at a geocentric distance of 6.6 R_E and at 150° W longitude. One can easily arrive at the Local Time for the beginning of the event by subtracting 10 hours from the Universal Time (or by adding 14 hours if the hour of the beginning time (U.T.) is less than 10).

Gaps of as much as an hour may occur between bursts in a given event. However, we define the duration of an event as the time interval between the beginning of the first burst and the end of the last burst.

We have used microfilm copies of the data at 0.32 second averages to measure the time interval between successive peaks. We tried to make at least ten such measurements during an event to determine the average period. In a few cases we were unable to make ten measurements, but in all cases we made at least five. The error figure associated with the average period is the standard deviation of the individual measurements of the period. This error figure is more a measure of the real variability of the time interval between successive peaks than it is of uncertainty in determining that time interval.

The average frequency was determined by inverting each individual measurement of the time interval between successive peaks and then averaging these individual measurements of the frequency. The error figure associated with the average frequency is the standard deviation of the individual measurements of the frequency.

Acknowledgements

28<

Low Frequency Oscillations in the Earth's Magnetic Field

Observed at ATS-1

April, 1968

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(milli-Hz)
01	Apr. 01	21	48	15	50.7 ± 8.5	20.3 ± 3.6
02	02	00	59	147	105.4 ± 13.1	9.6 ± 1.2
03	03	18	54	78	55.3 ± 5.0	18.2 ± 1.7
04	04	04	15	46	80.3 ± 6.7	12.5 ± 1.1
05	05	00	06	103	129.3 ± 11.7	7.8 ± 0.7
06	06	03	02	100	95.9 ± 28.5	11.3 ± 3.4
07	06	15	12	278	31.9 ± 6.3	32.6 ± 6.7
08	06	22	22	98	78.5 ± 3.6	12.8 ± 0.6
09	09	20	19	401	141.3 ± 17.1	7.2 ± 0.9
10	10	21	17	173	79.5 ± 6.7	12.7 ± 1.1
11	11	01	56	126	105.3 ± 9.9	9.6 ± 1.0
12[a]	11	16	02	13	125.4 ± 8.3	8.0 ± 0.5
13	13	06	55	125	54.5 ± 6.1	18.6 ± 2.2
14	13	21	56	34	45.5 ± 7.2	22.5 ± 3.6
15	13	23	30	128	61.0 ± 13.2	17.2 ± 4.2
16	14	05	56	34	38.7 ± 4.8	26.2 ± 3.7
17	15	01	10	310	59.5 ± 6.7	17.0 ± 1.9
18	15	19	39	102	27.1 ± 3.5	37.5 ± 5.0
19	17	00	22	48	29.4 ± 8.4	36.1 ± 8.7

29<

Event No.	Beginning Time (U.T.) Day	Hour	Min.	Duration (Min.)	Average Period T(Sec.)	Average Frequency f(Milli-Hz)
20	17	02	02	108	81.0 + 5.4	12.4 + 0.9
21	17	18	12	98	55.7 + 3.8	18.0 + 1.4
22	23	00	46	29	96.5 + 14.7	10.6 + 1.5
23	23	04	07	18	149.0 + 7.8	6.7 + 0.4
24	24	08	02	57	49.7 + 5.5	20.3 + 2.4
25	25	18	10	48	77.2 + 2.5	13.0 + 0.4
26[a]	26	03	12	53	212.7 + 30.4	4.8 + 0.7
27[a]	26	10	54	18	69.2 + 4.9	14.5 + 1.1
28	27	19	34	56	22.7 + 2.1	44.5 + 4.4
29	28	00	54	120	47.9 + 7.6	21.4 + 3.4
30	29	12	21	11	102.4 + 4.7	9.8 + 0.5
31	30	02	08	21	54.7 + 3.4	18.3 + 1.2
32	30	20	22	83	54.7 + 9.3	18.7 + 2.8

[a] Measurements made on B_z only.

30<

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During May, 1968

W. D. Cummings and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

April 19, 1974

Catalog of Low-Frequency Oscillations
of the
Earth's Magnetic Field as Observed at ATS-1

During May, 1968

W. D. Cummings and D. Lyons
Department of Physics
Grambling College
Grambling, LA   71245

Introduction

The attached catalog of events has been prepared to facilitate a comparison of ATS-1 data with other ground and satellite magnetometer data. We have begun the catalog in March, 1968, when the ATS-1 data begins to overlap data from the DODGE satellite. We hope to eventually catalog all our data for 1967, 1968, and 1969.

Explanation of the Catalog

In this catalog an _event_ is defined as an oscillation of the magnetic field with a duration of at least ten minutes, and a frequency that remains roughly constant. Events are distinguished on the basis of the frequency of the oscillation, e.g., when a high frequency oscillation is superimposed upon a lower frequency oscillation, two events are identified.

The oscillations of an event usually occur in bursts that are typically one hour in duration. In a burst the amplitude of the oscillation begins at a low level, grows to a maxium, and then decreases to a low level again. Because the oscillation begins with a low amplitude, it is often difficult to exactly specify the _beginning time_ of the event.

The beginning time is given in Universal Time. ATS-1 is stationed in the geographic equatorial plane at a geocentric distance of 6.6 R_E and at 150° W longitude. One can easily arrive at the Local Time for the beginning of the event by subtracting 10 hours from the Universal Time (or by adding 14 hours if the hour of the beginning time (U.T.) is less than 10).

Gaps of as much as an hour may occur between bursts in a given event. However, we defined the duration of an event as the time interval between the beginning of the first burst and the end of the last burst.

We have used microfilm copies of the data at 0.32 second averages to measure the time interval between successive peaks. We tried to make at least ten such measurements during an event to determine the average period. Ina few cases we were unable to make ten measurements, but in all cases we were unable to make ten measurements, but in all cases we made at least five. The error figure associated with the average period is the standard deviation of the individual measurements of the period. This error figure is more a measure of the real variability of the time interval between successive peaks than it is of uncertainty in determining that time interval.

The average frequency was determined by inverting each individual measurement of the time interval between successive peaks and then averaging these individual measurements of the frequency. The error figure associated with the average frequency is the standard deviation of the individual measurements of the frequency.

33<

Low Frequency Oscillations in the Earth's Magnetic Field

Observed at ATS-1

May, 1968

Event No.	Beginning Day	Time Hour	(U.T.) Min.	Duration (Min.)	Average Period T. (Sec.)	Average Frequency F (Milli-Hz)
01	May 01	22	09	199	85.8 ± 19.4	12.3 ± 3.1
02	02	04	09	75	48.0 ± 17.1	23.2 ± 7.6
03 [a]	02	04	45	65	198.8 ± 41.4	5.2 ± 1.2
04	02	23	32	577	50.4 ± 10.8	20.8 ± 5.1
05	04	00	38	32	28.8 ± 3.1	35.1 ± 4.2
06	06	21	511	46	34.0 ± 4.7	29.9 ± 3.8
07	07	01	06	144	81.4 ± 5.8	12.3 ± 0.9
08	09	08	12	16	48.7 ± 3.6	20.6 ± 1.6
09	09	14	20	12	72.0 ± 7.9	14.0 ± 1.6
10	09	19	33	387	71.7 ± 13.2	14.5 ± 3.2
11	10	04	10	50	158.0 ± 19.8	6.4 ± 0.8
12	10	23	47	23	60.4 ± 6.0	16.7 ± 1.8
13 [a]	11	02	22	32	133.2 ± 33.5	7.9 ± 1.7
14 [a]	11	06	26	20	225.2 ± 30.2	4.5 ± .7
15	11	10	27	188	109.5 ± 17.3	9.4 ± 1.8
16	11	16	05	334	32.2 ± 9.9	33.8 ± 9.9
17 [a]	12	00	39	31	126.0 ± 21.9	8.1 ± 1.4
18 [a]	12	03	20	23	126.7 ± 11.6	7.9 ± 0.7
19	12	15	32	156	28.7 ± 6.3	36.3 ± 7.4

Event No.	Beginning Day	Time Hour	(U.T.) Min.	Duration (Min.)	Average Period T. (Sec.)	Average Frequency P. (Milli-Hz)
20	12	19	59	256	26.4 ± 4.8	39.3 ± 8.4
21	12	22	38	32	55.5 ± 7.3	18.3 ± 2.5
22	13	08	45	15	52.1 ± 8.4	19.6 ± 3.2
23	13	16	02	94	27.5 ± 3.6	37.0 ± 5.1
24	13	19	14	205	30.2 ± 4.8	33.7 ± 4.4
25	13	20	26	282	76.8 ± 9.1	13.2 ± 1.5
26	14	21	33	13	54.0 ± 1.8	18.5 ± 0.6
27	16	00	16	37	26.6 ± .6	37.7 ± .9
28	16	00	59	21	59.7 ± 8.7	17.0 ± 2.4
29	16	04	07	10	60.6 ± 6.2	16.7 ± 1.8
30	16	23	08	157	73.6 ± 7.8	13.7 ± 1.5
31	17	08	05	124	28.5 ± 5.1	36.6 ± 6.9
32	17	21	50	103	64.9 ± 6.8	15.6 ± 1.7
33	18	01	20	55	123.4 ± 16.9	8.3 ± 1.3
34	20	13	01	28	78.7 ± 2.2	12.7 ± 0.4
35	21	00	39	31	40.4 ± 8.3	25.6 ± 5.3
36[a]	21	02	20	30	130.9 ± 24.7	7.9 ± 2.0
37	21	03	53	201	73.1 ± 10.4	14.0 ± 2.3
38	21	10	52	12	47.0 ± 4.1	21.4 ± 1.8
39	22	23	35	35	47.3 ± 3.8	21.3 ± 1.8
40[a]	24	02	49	18	157.2 ± 13.5	6.4 ± 0.6
41	26	22	10	213	152.3 ± 4.8	6.6 ± 0.2
42	29	00	00	32	112.7 ± 7.4	8.9 ± 0.6
43	29	06	39	62	47.5 ± 4.1	21.2 ± 1.8
44	29	22	48	35	67.7 ± 4.0	14.8 ± 0.9

Event No.	Beginning Day	Time (U.T.) Hour	Min.	Duration (Min.)	Average Period T. (Sec.)	Average Frequency P. (Milli-Hz)
45[a]	30	03	09	33	132.0 $\pm$ 23.9	7.8 $\pm$ 1.6
46	30	06	00	96	60.7 $\pm$ 9.8	16.9 $\pm$ 2.8
47	30	22	54	22	65.6 $\pm$ 1.9	15.3 $\pm$ 0.4

[a]Measurements made on B_z only.

36<